



[4910-13-P]

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 39**

**[Docket No. FAA-2018-0299; Product Identifier 2018-NM-060-AD; Amendment 39-19256; AD 2018-08-03]**

**RIN 2120-AA64**

**Airworthiness Directives; The Boeing Company Airplanes**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule; request for comments.

**SUMMARY:** We are adopting a new airworthiness directive (AD) for The Boeing Company Model 787-8 and 787-9 airplanes powered by Rolls-Royce plc (RR) Trent 1000-A2, Trent 1000-AE2, Trent 1000-C2, Trent 1000-CE2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, and Trent 1000-L2 turbofan engines. This AD requires revising the airplane flight manual to limit extended operations (ETOPS). This AD was prompted by a report from the engine manufacturer indicating that after an engine failure, prolonged operation at high thrust settings on the remaining engine during an ETOPS diversion may result in failure of the remaining engine before the diversion can be safely completed. We are issuing this AD to address the unsafe condition on these products.

**DATES:** This AD is effective [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

We must receive comments on this AD by [INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** You may send comments, using the procedures found in 14 CFR 11.43 and 11.45, by any of the following methods:

- Federal eRulemaking Portal: Go to <http://www.regulations.gov>. Follow the instructions for submitting comments.

- Fax: 202-493-2251.

- Mail: U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE., Washington, DC 20590.

- Hand Delivery: Deliver to Mail address above between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

### **Examining the AD Docket**

You may examine the AD docket on the Internet at <http://www.regulations.gov> by searching for and locating Docket No. FAA-**2018-0299**; or in person at Docket Operations between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this final rule, the regulatory evaluation, any comments received, and other information. The street address for Docket Operations (phone: 800-647-5527) is in the ADDRESSES section. Comments will be available in the AD docket shortly after receipt.

**FOR FURTHER INFORMATION CONTACT:** Tak Kobayashi, Aerospace Engineer, Propulsion Section, FAA, Seattle ACO Branch, 2200 South 216th Street, Des Moines, WA 98198; phone and fax: 206-231-3553; email: [Takahisa.Kobayashi@faa.gov](mailto:Takahisa.Kobayashi@faa.gov).

### **SUPPLEMENTARY INFORMATION:**

#### **Discussion**

Over the past year, we have been aware of several engine failures of Trent 1000 Package C engines due to failed compressor and turbine blades and seals. Package C engines are Rolls-Royce plc (RR) Trent 1000-A2, Trent 1000-AE2, Trent 1000-C2, Trent 1000-CE2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, and Trent 1000-L2 turbofan engines. During that same period,

under the management programs for those engine issues, we have been aware of numerous reports of engine inspection findings of cracked blades resulting in unscheduled engine removals. Boeing reported to the FAA that the engine manufacturer recently determined that intermediate pressure compressor (IPC) stage 2 blades have a resonant frequency that is excited by the airflow conditions existing in the engine during operation at high thrust settings under certain temperature and altitude conditions. The resultant blade vibration can result in cumulative fatigue damage that can cause blade failure and consequent engine shutdown. In the event of a single engine in-flight shutdown during the cruise phase of flight, thrust on the remaining engine is normally increased to maximum continuous thrust (MCT). During a diversion following a single engine shutdown under an ETOPS flight, the remaining engine may operate at MCT for a prolonged period, under which the IPC stage 2 blades would be exposed to the resonant frequency condition. Therefore, an ETOPS diversion will put the remaining engine at an operating condition that would significantly increase the likelihood of failure of the remaining engine. In addition, if the remaining engine already had cracked IPC stage 2 blades, the likelihood of the remaining engine failing will further increase before a diversion can be safely completed.

#### **FAA's Determination**

We are issuing this AD because we evaluated all the relevant information and determined the unsafe condition described previously is likely to exist or develop in other products of the same type design.

#### **AD Requirements**

This AD requires revising the AFM to limit ETOPS operation.

#### **Interim Action**

This AD is interim action. The manufacturer is currently developing a modification that will address the unsafe condition identified in this AD. Once this

modification is developed, approved, and available, we might consider additional rulemaking.

### **FAA's Justification and Determination of the Effective Date**

An unsafe condition exists that requires the immediate adoption of this AD without providing an opportunity for public comments prior to adoption. The FAA has found that the risk to the flying public justifies waiving notice and comment prior to adoption of this rule because unrecoverable thrust loss on both engines could lead to a forced landing. Therefore, we find good cause that notice and opportunity for prior public comment are impracticable. In addition, for the reasons stated above, we find that good cause exists for making this amendment effective in less than 30 days.

### **Comments Invited**

This AD is a final rule that involves requirements affecting flight safety and was not preceded by notice and an opportunity for public comment. However, we invite you to send any written data, views, or arguments about this final rule. Send your comments to an address listed under the ADDRESSES section. Include the docket number FAA-2018-0299 and Product Identifier 2018-NM-060-AD at the beginning of your comments. We specifically invite comments on the overall regulatory, economic, environmental, and energy aspects of this final rule. We will consider all comments received by the closing date and may amend this final rule because of those comments.

We will post all comments we receive, without change, to <http://www.regulations.gov>, including any personal information you provide. We will also post a report summarizing each substantive verbal contact we receive about this final rule.

### **Costs of Compliance**

We estimate that this AD affects 14 airplanes of U.S. registry. We estimate the following costs to comply with this AD:

### Estimated costs

Action	Labor cost	Parts cost	Cost per product	Cost on U.S. operators
AFM revisions	1 work-hour X \$85 per hour = \$85	\$0	\$85	\$1,190

### Authority for this Rulemaking

Title 49 of the United States Code specifies the FAA’s authority to issue rules on aviation safety. Subtitle I, section 106, describes the authority of the FAA Administrator. “Subtitle VII: Aviation Programs” describes in more detail the scope of the Agency’s authority.

We are issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701: “General requirements.” Under that section, Congress charges the FAA with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it addresses an unsafe condition that is likely to exist or develop on products identified in this rulemaking action.

This AD is issued in accordance with authority delegated by the Executive Director, Aircraft Certification Service, as authorized by FAA Order 8000.51C. In accordance with that order, issuance of ADs is normally a function of the Compliance and Airworthiness Division, but during this transition period, the Executive Director has delegated the authority to issue ADs applicable to transport category airplanes and associated appliances to the Director of the System Oversight Division.

### Regulatory Findings

This AD will not have federalism implications under Executive Order 13132. This AD will not have a substantial direct effect on the States, on the relationship between the

national government and the States, or on the distribution of power and responsibilities among the various levels of government.

For the reasons discussed above, I certify that this AD:

- (1) Is not a “significant regulatory action” under Executive Order 12866,
- (2) Is not a “significant rule” under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979),
- (3) Will not affect intrastate aviation in Alaska, and
- (4) Will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

#### **List of Subjects in 14 CFR Part 39**

Air transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

#### **Adoption of the Amendment**

Accordingly, under the authority delegated to me by the Administrator, the FAA amends 14 CFR part 39 as follows:

#### **PART 39 - AIRWORTHINESS DIRECTIVES**

- 1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

#### **§ 39.13 [Amended]**

- 2. The FAA amends § 39.13 by adding the following new airworthiness directive (AD):

**2018-08-03 The Boeing Company:** Amendment 39-19256 ; Docket

No. FAA-2018-0299; Product Identifier 2018-NM-060-AD.

#### **(a) Effective Date**

This AD is effective [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**(b) Affected ADs**

None.

**(c) Applicability**

This AD applies to The Boeing Company Model 787-8 and 787-9 airplanes, certificated in any category, powered by Rolls-Royce plc (RR) Trent 1000-A2, Trent 1000-AE2, Trent 1000-C2, Trent 1000-CE2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, and Trent 1000-L2 turbofan engines.

**(d) Subject**

Air Transport Association (ATA) of America Code 71, Power plant.

**(e) Unsafe Condition**

This AD was prompted by a report from the engine manufacturer indicating that after an engine failure, prolonged operation at high thrust settings on the remaining engine during an extended-operation (ETOPS) diversion may result in failure of the remaining engine before the diversion can be safely completed. We are issuing this AD to address unrecoverable thrust loss on both engines, which could lead to a forced landing.

**(f) Compliance**

Comply with this AD within the compliance times specified, unless already done.

**(g) Revision of Limitations Chapter in Airplane Flight Manual (AFM)**

Within 3 days after the effective date of this AD, revise the Certificate Limitations chapter of the applicable Boeing AFM Engine Appendix by incorporating the information in figure 1 to paragraph (g) of this AD. Where figure 1 to paragraph (g) of this AD refers to a “Trent 1000 2 engine,” this term means all engines identified in paragraph (c) of this AD. This may be accomplished by inserting a copy of this AD into the AFM. When information identical to that in figure 1 to paragraph (g) of this AD has been included in the Certificate Limitations chapter of the general revisions of the AFM,

the general revisions may be inserted into the AFM, and the copy of this AD may be removed from the AFM.

**Figure 1 to paragraph (g) of this AD – AFM Certificate Limitations**

**Engine Appendix - Certificate Limitations**

**(Required by AD 2018-08-03)**

**ETOPS**

The following information applies to 787-8 and 787-9 airplanes equipped with a RR Trent 1000 series engine that has a numeral “2” at the end of the model number installed on either wing, and that has 300 or more total accumulated engine flight cycles.

To ensure continued safe flight during ETOPS, planned aircraft gross weight must not exceed those specified in the ETOPS Section of the Performance Chapter prior to operating more than 60 minutes from a suitable airport.

**ETOPS Diversion Speeds and Times**

ETOPS Single Engine Driftdown diversion must be planned and flown at Engine-Out Long Range Cruise speed. Maximum diversion time for single engine driftdown must not exceed 140 minutes.

ETOPS Decompression diversion at 10,000 feet must be planned and flown at Mach 0.55. For intermediate altitude level offs above 10,000 feet, Long Range Cruise speed must be used.

**(h) Revision of Performance Chapter of AFM**

Concurrently with accomplishment of the requirements of paragraph (g) of this AD, revise the Performance chapter of the applicable Boeing AFM Engine Appendix by incorporating the information in figure 2 to paragraph (h) of this AD. This may be accomplished by inserting a copy of this AD into the AFM. When information identical to that in figure 2 to paragraph (h) of this AD has been included in the Performance chapter of the general revisions of the AFM, the general revisions may be inserted into the AFM, and the copy of this AD may be removed from the AFM.

**Figure 2 to paragraph (h) of this AD – AFM Performance**

**Engine Appendix – Performance**

**ETOPS**

ETOPS operation of a Model 787-8 or 787-9 airplane equipped with a RR Trent 1000 A2, C2, or E2 series engine is prohibited.

As outlined in the ETOPS Section of the Certificate Limitations Chapter, the following table must be utilized when planning ETOPS flights.

**(D631Z003-9R64EF) 787-9 Trent 1000-AE2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	
Minimum Engine-Out Cruise Altitude (ft)		19,000	19,000	18,800	18,500	18,300	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	499,000	497,400	477,500	453,000	428,400	Prohibited
	KGS	226,360	225,650	216,620	205,480	194,350	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	425,900	417,000	396,300	367,300	338,200	Prohibited
	KGS	193,210	189,170	179,800	166,610	153,420	

**(D631Z003-9R7072F) and (D631Z003- 9R7072E) 787-9 Trent 1000-D2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	
Minimum Engine-Out Cruise Altitude (ft)		19,100	19,100	18,900	18,700	18,500	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	510,300	508,400	488,200	465,800	443,400	Prohibited
	KGS	231,500	230,640	221,480	211,310	201,130	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	438,300	429,300	408,400	383,800	359,300	Prohibited
	KGS	198,830	194,760	185,240	174,110	162,970	

**(D631Z003-9R74F) and (D631Z003-9R74E) 787-9 Trent 1000-J2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	
Minimum Engine-Out Cruise Altitude (ft)		19,300	19,300	19,100	18,800	18,500	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	530,400	527,800	507,800	479,500	451,100	Prohibited
	KGS	240,600	239,430	230,370	217,510	204,640	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	455,200	446,600	430,200	401,400	372,500	Prohibited
	KGS	206,470	202,580	195,140	182,070	169,000	

**(D631Z003-R7475F) and (D631Z003-R7475E) 787-9 Trent 1000-K2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,300	19,300	19,100	18,800	18,500	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	530,400	527,800	507,800	479,500	451,100	Prohibited
	KGS	240,600	239,430	230,370	217,510	204,640	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	455,200	446,600	430,200	401,400	372,500	Prohibited
	KGS	206,470	202,580	195,140	182,070	169,000	

**(D631Z003-R70EF) 787-8 Trent 1000-CE2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,300	19,300	19,100	18,900	18,600	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	525,100	523,100	501,400	476,300	451,100	Prohibited
	KGS	238,200	237,310	227,450	216,040	204,630	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	446,700	438,600	419,400	396,300	373,300	Prohibited
	KGS	202,650	198,970	190,260	179,790	169,330	

**(D631Z003-R7072F) and (D631Z003-R7072E) 787-8 Trent 1000-D2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,300	19,300	19,100	18,900	18,600	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	525,100	523,100	501,400	476,300	451,100	Prohibited
	KGS	238,200	237,310	227,450	216,040	204,630	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	446,700	438,600	419,400	396,300	373,300	Prohibited
	KGS	202,650	198,970	190,260	179,790	169,330	

**(D631Z003-R70LF) 787-8 Trent 1000-L2**

		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,300	19,300	19,100	18,900	18,600	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	525,100	523,100	501,400	476,300	451,100	Prohibited
	KGS	238,200	237,310	227,450	216,040	204,630	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	446,700	438,600	419,400	396,300	373,300	Prohibited
	KGS	202,650	198,970	190,260	179,790	169,330	

<b>(D631Z003-R67F) and (D631Z003-R67E) 787-8 Trent 1000-G2</b>							
		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,200	19,200	19,000	18,700	18,400	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	512,800	511,100	488,900	461,500	434,100	Prohibited
	KGS	232,600	231,860	221,780	209,340	196,910	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	436,300	426,700	405,700	383,400	361,100	Prohibited
	KGS	197,910	193,550	184,020	173,910	163,810	

  

<b>(D631Z003-R64EF) and (D631Z003-R64EE) 787-8 Trent 1000-AE2</b>							
		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		19,200	19,200	19,000	18,700	18,400	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	512,800	511,100	488,900	461,500	434,100	Prohibited
	KGS	232,640	231,870	221,770	209,340	196,900	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	436,200	426,600	405,600	383,400	361,100	Prohibited
	KGS	197,860	193,500	184,020	173,910	163,810	

  

<b>(D631Z003-R58F) 787-8 Trent 1000-H2</b>							
		Enroute Diversion Temperature					
		ISA+0 Degrees C and Below	ISA+10 Degrees C	ISA+15 Degrees C	ISA+20 Degrees C	ISA+25 Degrees C	Above ISA+25 Degrees C
Minimum Engine-Out Cruise Altitude (ft)		18,900	18,800	18,600	18,200	17,900	Prohibited
Maximum Planned Weight at ETOPS Entry Point without Forecast Icing	LBS	474,000	471,600	447,400	416,700	386,000	Prohibited
	KGS	215,000	213,940	202,970	189,040	175,100	
Maximum Planned Weight at ETOPS Entry Point with Forecast Icing	LBS	404,400	394,900	371,700	346,700	321,700	Prohibited
	KGS	183,470	179,120	168,630	157,270	145,910	

**(i) Alternative Methods of Compliance (AMOCs)**

(1) The Manager, Seattle ACO Branch, FAA, has the authority to approve AMOCs for this AD, if requested using the procedures found in 14 CFR 39.19. In accordance with 14 CFR 39.19, send your request to your principal inspector or local Flight Standards District Office, as appropriate. If sending information directly to the manager of the certification office, send it to the attention of the person identified in

paragraph (j) of this AD. Information may be emailed to: 9-ANM-Seattle-ACO-AMOC-Requests@faa.gov

(2) Before using any approved AMOC, notify your appropriate principal inspector, or lacking a principal inspector, the manager of the local flight standards district office/certificate holding district office.

(3) An AMOC that provides an acceptable level of safety may be used for any repair, modification, or alteration required by this AD if it is approved by the Boeing Commercial Airplanes Organization Designation Authorization (ODA) that has been authorized by the Manager, Seattle ACO Branch, to make those findings. To be approved, the repair method, modification deviation, or alteration deviation must meet the certification basis of the airplane, and the approval must specifically refer to this AD.

**(j) Related Information**

For more information about this AD, contact Tak Kobayashi, Aerospace Engineer, Propulsion Section, FAA, Seattle ACO Branch, 2200 South 216th Street, Des Moines, WA 98198; phone and fax: 206-231-3553; email: Takahisa.Kobayashi@faa.gov.

**(k) Material Incorporated by Reference**

None.

Issued in Des Moines, Washington, on April 12, 2018.

Jeffrey E. Duven,  
Director,  
System Oversight Division,  
Aircraft Certification Service.

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